Claims

[c1] What is claimed is:

1. A scanning range sensor for determining distance to an object by scanning a beam from a light projector onto the object and receiving in a light receiving section connected to a distance computation circuit light reflected from the object, the scanning range sensor comprising:

a light projector having a light source;

a rotary member separate from said light projector and rotative about a rotational axis, said rotary member having at least a circumferential wall portion and a top wall portion;

a light transmitting window formed alongside said circumferential wall portion of said rotary member;

a scanning mirror disposed on said top wall portion of said rotary member, for deflecting a beam from said light projector radially outward through said light transmitting window;

a reflecting mirror disposed on said top wall portion of said rotary member, for guiding to the light receiving section light reflected from an object;

a stator disposed coaxially with, for imparting rotational driving force to, said rotary member;

a stationary shaft disposed at the center of said stator along the rotational axis of said rotary member;
a rotational position detector for detecting rotational position of said rotary member; and
a photodetector as a component of the light receiving section, disposed on the stationary shaft and connected to the distance computation circuit, wherein said circumferential and top wall portions of said rotary member surround said photodetector.

[c2] 2. The scanning range sensor according to claim 1, the light receiving section having an upper surface intersecting at the center thereof the rotational axis of said rotary member, further comprising:
a scanning optical system for guiding a scanning beam from said light projector to said scanning mirror; and
a receiving optical system for condensing onto the center of the light-receiving-section upper surface received light reflected by said reflecting mirror; wherein
at least one of said scanning optical system and said receiving optical system is housed in a space enclosed by said top and circumferential wall portions of said rotary member, and said photodetector.

[c3] 3. The scanning range sensor according to claim 1, wherein signals obtained by said photodetector and output signals from said rotational position detector are

transmitted to the distance computation circuit interiorly through said stationary shaft.

[c4] 4. The scanning range sensor according to claim 2, wherein:
said scanning optical system guides along the rotational axis the scanning beam from said light projector so that the scanning beam is while held on the rotational axis incident on said scanning mirror; and
said receiving optical system guides along the rotational axis light reflected by said reflecting mirror so as to focus along the rotational axis the light onto said photodetector.

[c5] 5. The scanning range sensor according to claim 1, wherein said light source is one selected from a laser and an LED.

[c6] 6. A scanning range sensor for determining distance to an object by scanning a beam from a light projector onto the object and receiving in a photodetector connected to a distance computation circuit light reflected from the object, the scanning range sensor comprising:
a light projector having a light source;
a rotary member separate from said light projector and rotative about a rotational axis, said rotary member having at least a circumferential wall portion and a top wall

portion;
a stator disposed coaxially with, for imparting rotational driving force to, said rotary member;
a stationary shaft disposed at the center of said stator along the rotational axis of said rotary member;
a rotational position detector for detecting rotational position of said rotary member;
a photodetector fixedly arranged proximate one end of said stationary shaft, in a position where the center of said photodetector coincides with the rotational axis, and connected to the distance computation circuit by a signal wire;
a scanning mirror fixed to one wall surface of said rotary member so as to be inclined at a predetermined angle with respect to the rotational axis, for deflecting a scanning beam from said light projector to project the beam radially out of said rotary member into space surrounding the scanning range sensor;
a reflecting mirror fixed to another wall surface of said rotary member so as to be inclined at a predetermined angle with respect to the rotational axis, for reflecting light received into the scanning range sensor from an object in the surrounding space and guiding the light onto said photodetector; and
an optical system for guiding along the rotational axis the scanning beam from said light projector so that the

beam is held on the rotational axis while being incident on the scanning mirror; wherein
based on signals generated by said photodetector and said rotational position detector the distance computation circuit calculates distance to the object.

[c7] 7. The scanning range sensor according to claim 6, wherein said rotary member is rotated in one direction continuously.

[c8] 8. The scanning range sensor according to claim 6, wherein said rotary member is swung in a reciprocating movement within a predetermined angle range.

[c9] 9. The scanning range sensor according to claim 6, wherein the distance computation circuit calculates distance to objects using an AM modulation method.

[c10] 10. The scanning range sensor according to claim 6, wherein said rotational position detector is a resolver for detecting rotational angle.

[c11] 11. The scanning range sensor according to claim 6, wherein:
a bearing is disposed on the outer circumferential surface of the stationary shaft for rotatably supporting said rotary member;
a rotor magnet is fixed onto said rotary member so as to

face said stator for generating rotational force, said rotor magnet and said stator therein constituting a motor unit; and

a through-hole is formed in said stationary shaft to allow signal wires from said photodetector and said rotational position detector to be connected to the distance computation circuit via the through-hole.

[c12] 12. The scanning range sensor according to claim 6, wherein said light source is one selected from a laser and an LED.

[c13] 13. A scanning range sensor for determining distance to an object by scanning a beam from a light projector onto the object and receiving in a photodetector connected to a distance computation circuit light reflected from the object, the scanning range sensor comprising:

an outer cover including a cylindrical wall and an annular transparent window in a portion of said cylindrical wall;

a cylindrical rotary member arranged inside said outer cover for being rotated about its rotational axis by a motor unit, said rotary member having at least a circumferential wall portion and a top wall portion;

a light receiving window including an optical lens and formed in said circumferential wall portion of said rotary member at the same height as said transparent window, said optical lens for guiding through said transparent

window and said light receiving window, radially into said rotary member, light reflected from an object in the space surrounding the scanning range sensor;
a light projector having a light source and arranged between said outer cover and said cylindrical rotary member;
a stator disposed coaxially with, for imparting rotational driving force to, said rotary member;
a stationary shaft disposed at the center of said stator along the rotational axis of said rotary member;
a rotational position detector for detecting rotational position of said rotary member;
a photodetector fixedly arranged proximate an upper portion of said stationary shaft, in a position where the center of said photodetector coincides with the rotational axis, and connected to the distance computation circuit by a signal wire;
a scanning mirror fixed to an outer surface of said top wall portion of said rotary member so as to be inclined at a predetermined angle with respect to the rotational axis, for deflecting a scanning beam from said light projector to project the beam radially out of said rotary member and through said transparent window into the surrounding space;
a reflecting mirror fixed to an inner surface of said top wall portion of said rotary member so as to be inclined at

a predetermined angle with respect to the rotational axis, for reflecting light received into said rotary member from said optical lens and guiding the light onto said photodetector to allow the distance computation circuit to calculate distance to the object; and

an optical system including at least one mirror arranged on an inner surface of said outer cover, for guiding along the rotational axis the scanning beam from said light projector so as to be along the rotational axis incident on the scanning mirror.

[c14] 14. The scanning range sensor according to claim 13, wherein said rotary member is rotated in one direction continuously.

[c15] 15. The scanning range sensor according to claim 13, wherein said rotary member is swung in a reciprocating movement within a predetermined angle range.

[c16] 16. The scanning range sensor according to claim 13, wherein said rotational position detector is a resolver for detecting rotational angle.

[c17] 17. The scanning range sensor according to claim 13, wherein:

a bearing is disposed on the outer circumferential surface of said stationary shaft for rotatably supporting said

rotary member;

a rotor magnet is fixed onto said rotary member so as to face said stator for generating rotational force, said rotor magnet and said stator therein constituting a motor unit; and

a through-hole is formed in said stationary shaft to allow signal wires from said photodetector and said rotational position detector to be connected to the distance computation circuit via the through-hole.

[c18] 18. The scanning range sensor according to claim 13, wherein said light source is one selected from a laser and an LED.

[c19] 19. A scanning range sensor for determining distance to an object by scanning a beam from a light projector onto the object and receiving in a photodetector connected to a distance computation circuit light reflected from the object, the scanning range sensor comprising:

a motor including a stationary shaft, a stator, and a rotary member rotative on the motor rotational axis and having at least a circumferential wall portion and a first optical through-hole encompassing the rotational axis;

a light receiving window including an optical lens and formed in said circumferential wall portion of said rotary member, said optical lens for guiding through said light receiving window, radially into said rotary member, light

reflected from an object in the space surrounding the scanning range sensor;
a light projector including a light source, the light projector being arranged on and fixed to said stationary member;
a photodetector fixedly arranged proximate an upper portion of said stationary shaft, in a position where the center of said photodetector coincides with the rotational axis, and connected to the distance computation circuit by a signal wire;
a scanning mirror fixed to an outer wall surface of said rotary member so as to be inclined at a predetermined angle with respect to the rotational axis, for deflecting a scanning beam from said light projector to project the beam radially out of said rotary member into the surrounding space;
a half-silvered mirror for deflecting onto the rotational axis a scanning beam from said light projector so as to be along the rotational axis incident on the scanning mirror,
a reflecting mirror fixed to an inner wall of the rotary member so as to be inclined at a predetermined angle with respect to the rotational axis, said reflecting mirror having a second optical through-hole encompassing said rotational axis for together with the first optical through-hole permitting the scanning beam deflected by

the half-silvered mirror to travel along the rotational axis to the scanning mirror, said reflecting mirror for reflecting light received into said rotary member from said optical lens and guiding the light onto said photodetector to allow the distance computation circuit to calculate distance to the object.

[c20] 20. The scanning range sensor according to claim 19, wherein a through-hole is formed in said stationary shaft to allow signal wires from said photodetector and said rotational position detector to be connected to the distance computation circuit via the through-hole.

[c21] 21. The scanning range sensor according to claim 19, wherein said light source is one selected from a laser and an LED.